

We claim:

1. A computer readable storage medium having stored data representing instructions executable by a computer to monitor a catalytic device coupled in an exhaust of an internal combustion engine of a vehicle, said storage medium comprising:

instructions for determining a lean operation time during which the engine is operated lean;

instructions for determining a rich operation time during which the engine is operated rich;

10 instructions for determining a ratio between said lean time and said rich time; and

instructions for determining degradation of the catalyst based on said ratio.

15 2. The medium of claim 1, wherein said instructions for determining degradation of the catalyst based on said ratio further comprise:

instructions for retrieving a stored expected ratio as a function of operating conditions; and

20 comparing said expected ratio to said determined ratio to determine degradation of the catalyst.

3. The medium of claim 2, wherein said stored expected ratio is stored as a function of said lean time.

4. The medium of claim 1, further comprising:

instructions for correcting said rich operation time based
on a level of richness during said rich operation and an exhaust
5 gas flow rate during said rich operation;

instructions for correcting said lean operation time based
on a NO_x concentration during said lean operation and an exhaust
gas flow rate during said lean operation; and

instructions for determining said ratio between said
10 corrected lean time and said corrected rich time.

5. The medium of claim 1, further comprising:

instructions for correcting said rich operation time based
on a level of richness during said rich operation;

15 instructions for correcting said lean operation time based
on an exhaust gas flow rate during said lean operation; and

instructions for determining said ratio between said
corrected lean time and said corrected rich time.

6. The medium of claim 1, further comprising:
instructions for correcting said rich operation time based
on a level of richness during said rich operation;
instructions for correcting said lean operation time based
5 on a NO_x concentration during said lean operation; and
instructions for determining said ratio between said
corrected lean time and said corrected rich time.

7. The medium of claim 1, further comprising instructions
10 for controlling said lean operation based on an estimate of an
amount of NO_x stored in the catalyst.

8. The medium of claim 7, further comprising instructions
for controlling said rich operation based on a signal from an
15 exhaust gas oxygen sensor coupled downstream of said catalyst.

9. A computer readable storage medium having stored data representing instructions executable by a computer to monitor a catalytic device coupled in an exhaust of an internal combustion engine of a vehicle, said storage medium comprising:

5 instructions for operating the engine lean;

 instructions for ending said lean operation when an amount of NO_x stored in the catalyst approaches a maximum capacity for NO_x storage;

 instructions for determining a lean operation time;

10 instructions for operating the engine rich after said lean operation is ended;

 instructions for ending said rich operation when stored NO_x is released based on a downstream air-fuel sensor;

 instructions for determining a rich operation time;

15 instructions for correcting said rich operation time based on a level of richness during said rich operation;

 gas flow rate during said rich operation;

 instructions for correcting said lean operation time based on a NO_x concentration during said lean operation;

20 gas flow rate during said lean operation;

 instructions for determining a ratio between said corrected lean time and said corrected rich time; and

 instructions for determining degradation of the catalyst based on said ratio.

10. The medium of claim 9, wherein said instructions for
ending said lean operation further comprise instructions for
ending said lean operation when an estimated amount of NO_x
5 stored in the catalyst approaches said maximum capacity for NO_x
storage.

11. The medium of claim 9, wherein said instructions for
determining degradation of the catalyst based on said ratio
10 further comprise:

instructions for retrieving a stored expected ratio as a
function of operating conditions; and
comparing said expected ratio to said determined ratio to
determine degradation of the catalyst.

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12. The medium of claim 11, wherein said stored expected
ratio is stored as a function of said lean time.

13. The medium of claim 1, further comprising:

instructions for correcting said rich operation time based on a level of richness during said rich operation and an exhaust gas flow rate during said rich operation;

5 instructions for correcting said lean operation time based on a NO_x concentration during said lean operation and an exhaust gas flow rate during said lean operation; and

instructions for determining said ratio between said corrected lean time and said corrected rich time.

14. A computer readable storage medium having stored data representing instructions executable by a computer to monitor a catalytic device coupled in an exhaust of an internal combustion engine of a vehicle, said storage medium comprising:

- 5 instructions for operating the engine lean;
- instructions for ending said lean operation based on a NOx sensor coupled downstream of the catalyst;
- instructions for determining a lean operation time;
- instructions for operating the engine rich after said lean 10 operation is ended;
- instructions for ending said rich operation when stored NOx is released based on a air-fuel sensor coupled in the exhaust;
- instructions for determining a rich operation time;
- instructions for correcting said rich operation time based 15 on a level of richness during said rich operation and an exhaust gas flow rate during said rich operation;
- instructions for correcting said lean operation time based on a NOx concentration during said lean operation and an exhaust gas flow rate during said lean operation;
- 20 instructions for determining a ratio between said corrected lean time and said corrected rich time;
- instructions for retrieving a stored expected ratio as a function of said corrected lean time;

instructions for comparing said ratio to said expected ratio; and

instructions for determining degradation of the catalyst based on said comparison.